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LAND USE / LAND COVER CHANGE DETECTION BY MULTI-TEMPORAL REMOTE SENSING IMAGERIES: BANGALORE CITY INDIA (1992-2012)

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ABSTRACT

Land use and land cover (LULC) changes is a dynamic, widespread and accelerating process, mainly driven by natural phenomena and anthropogenic activities, which in turn drives changes that world impact natural ecosystem. Change detection is one of the landscape ecological aims. Main aim of this study is to prepare land use land cover and their change detections by using remote sensing and GIS techniques. This paper presents the land use/land cover changes that have taken place in Bangalore, from 1992 to 2012.The study has been done through Landsat & IRS imagery from 1992, 2000, 2004, 2005, 2006, 2009 and 2012. The land use and land cover classification maps were prepared through remote sensing and GIS technology. The results indicate that there was a significant increasing trend in built up land and decreasing trend in agricultural land.

KEYWORDS: Land Use/Cover, Change Detection, Urbanisation, Remote Sensing, GIS

INTRODUCTION

Land use / Land cover exhibits the physical and economical situation of any region. Land-use refers to the way in which land has been used by humans and their habitat, usually with accent on the functional role of land for economic activities. Land-cover refers to the physical characteristics of earth's surface, captured in the distribution of vegetation, water, soil and other physical features of the land, including those created solely by human activities e.g., settlements. Land use/Land cover change information has an important role to play at local and regional as well as at macro level planning. The land-cover changes occur naturally in a progressive and gradual way, however some times it may be rapid and abrupt due to anthropogenic activities.

Remote sensing data of better resolution at different time interval help in analysing the rate of changes as well as the causal factors or drivers of changes. Hence it has a significant role in regional planning at different spatial and temporal scales. This along with the spatial and temporal analysis technologies namely Geographic Information System (GIS) and Global Positioning System (GPS) help in maintaining up-to date land-use dynamics information for a sound planning and a cost-effective decision.

OBJECTIVES

The main objective of the present paper is to analyse the nature and extent land use/land cover changes in Bangalore Mahanagar Palike (BBMP) in the past 2 decades and to identify the main forces behind the changes.

STUDY AREA

The city of Bangalore is located at a latitude of 12°58°N and longitude of 77°35°E at an altitude of 921 m above mean sea level .The city is state capital of Karnataka is located on the southern part of the Deccan Plateau at the border of

two other South Indian states, Tamil Nadu and Andhra Pradesh.. Since the 1980s, Bangalore has enjoyed the reputation of being one of the fastest growing cities in Asia The Bangalore metropolitan area covers an area of 725 sq km, and is the fifth largest city in India. The mean annual total rainfall is about 880 mm with about 60 rainy days a year over the last ten years. The summer temperature ranges from 18 °C to 38 °C, while the winter temperature ranges from 12 °C to 25 °C. Thus, Bangalore enjoys a salubrious climate all year round

METHODOLOGY

Three false colour composite (FCC) subsets images from Landsat TM and ETM, IRS P-6 dated (1992, 2000, 2004, 2005, 2006, 2009, and 2012) covering the study area (725 Sq kilometer for BBMP jurisdiction) were used in this study. Interpretation strategies were applied depending on satellite image interpretation and morphological and differences physical properties (colour, texture, structure…etc). Geo -referencing was used to correct and adapt the land sat image geometrically, so that they had comparable resolution and projection as the other data sets.

The geometric correction was executed by a first order transformation (affined transformation). Image to image model was used to correct the other images. GIS analysis were used to analyze and recalculated the changes.

Data Acquisition: Remote sensing data are primary sources for LULC change detection studies. Satellite data are suitable for computer processing due to the advantage of repetitive data acquisition, synoptic view and digital format. LANDSAT (MSS, TM and ETM+) and IRS LISS-III were acquired and used to evaluate LULC changes. Table 1 shows details information about the satellite images used in this work.

Table 1: Details of Satellite Imageries Used

Sl No	Satellites	Sensors	Date	Resolution	No of Bands	Path	Row
1	Landsat	TM	Jan 1992	28.5 m	7	144	51
2	Landsat7	ETM+	Nov-2000	28.5 m	7	144	51
3	Landsat7	ETM+	Nov-2004	28.5 m	7	144	51
4	IRS-P6	LISS-III	Feb2005	23.5 m	4	100	64
5	IRS-P6	LISS-III	March 2006	23.5 m	4	100	64
6	IRS-P6	LISS-III	Feb 2009	23.5 m	4	100	64
7	IRS-P6	LISS-III	May2012	23.5 m	4	100	64

Image Classification: Classification is the process of sorting pixel into finite number of individual classes. All satellite data were studied using spectral and spatial profile to ascertain the digital numbers of different LULC categories prior to classification. We used ISODATA (Iterative Self Organizing Data Analysis Technique) algorithm to perform unsupervised classification .Five land cover classes namely built-up area, agricultural land, water bodies, barren area and shrubs are identified in the study area. Methodology Adopted for Thematic Data Extraction from the Satellite Imageries is shown in figure1.

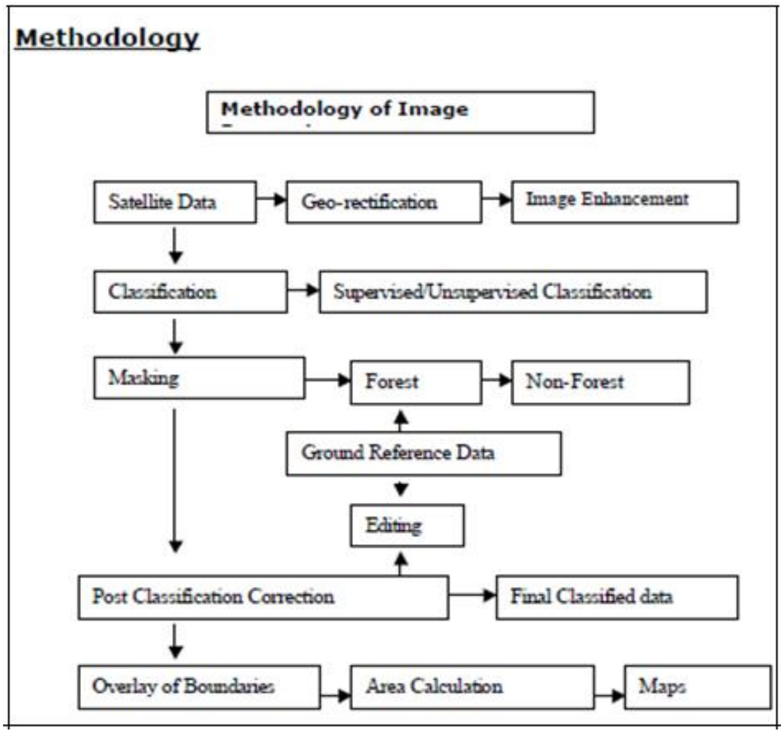


Figure 1: Flow Chart Illustrating the Methodology of Digital Image Processing

RESULTS AND DISCUSSIONS

Analysis of Land Use / Land Cover by Remote Sensing Data

The various Land use / Land cover classes interpreted in the study area include, built-up land, agricultural land (crop land and fallow land), forest (dense & degraded forest, and plantation), water bodies and wastelands(land with scrub, land without scrub and barren rocky areas), which are shown in table 2. Detailed accounts of these Land Use / Land Cover classes of the study area are described in the following sections shown in Maps from 1992 to 2012 (Figure 2).

The urban landscape of Bengaluru, has been transformed since the reforms of industrial, trade, and agricultural policies at both the central and state levels have created an investor-friendly environment that has encouraged foreign direct investment and fostered economic and urban growth. Located in the South India state of Karnataka, Bengaluru had an estimated population of 6.5 million in 2006, making it the fourth-largest city in India (Mumbai, New Delhi, and Kolkata are larger). Citing Bengaluru's numerous technology institutes, learning centers, and large skilled labour pool as comparative advantages, multinational information technology (IT) and high-tech corporations such as IBM, Microsoft, and Motorola now have major operations in the city. The development of Bengaluru's IT and associated industries has reshaped the urban environment.

Our analysis of urban growth in Greater Bengaluru uses Landsat & IRS imagery from 1992, 2000, 2004, 2005, 2006, 2010 and 2012. Preliminary results indicate that the period 1992 to 2000 was the most significant in terms of urban expansion, with most change occurring on the edges most notably on the southern edges of the city rather than through infilling in the city core. Urban growth during this period is characterized by intensive road building, especially around the city in an effort to connect Bengaluru to other major cities around the country. For the period 2000 to 2006, growth is evident in the east and south, following the development of industrial parks and residential communities. New growth is also evident in the northeast near the new international airport.

Table 2: Areas of Landuse/ Land Cover Classes in the Study Area

Sl No	Landuse Type	Area(Ha)						
		1992	2000	2004	2005	2006	2009	2012
1	Built-Up	8233	26678	41485	41880	42794	49652	52799
2	Agriculture	34149	21613	16719	16234	17244	16652	15027
3	Forest/ Plantation	12375	9645	1400	1290	910	578	863
4	Water Bodies	4817	3752	2978	3201	2883	3087	1331
5	Waste Land	12876	10762	9868	9845	8619	2481	2430
	Total	**72450**	**72450**	**72450**	**72450**	**72450**	**72450**	**72450**

Growth of Bangalore Urban Agglomerate

Analysis of increase in population as refered to table 3, has revealed that in Bangalore there is a significant in-migration from nearby towns and villages to the city as compared to natural increase of population. There has been an abysmally low performance of all urban local bodies in meeting the demands of citizens in the last two decades where there has been significant growth in population. The increase in number of slums in Bangalore is a growing problem and has not stabilized yet.

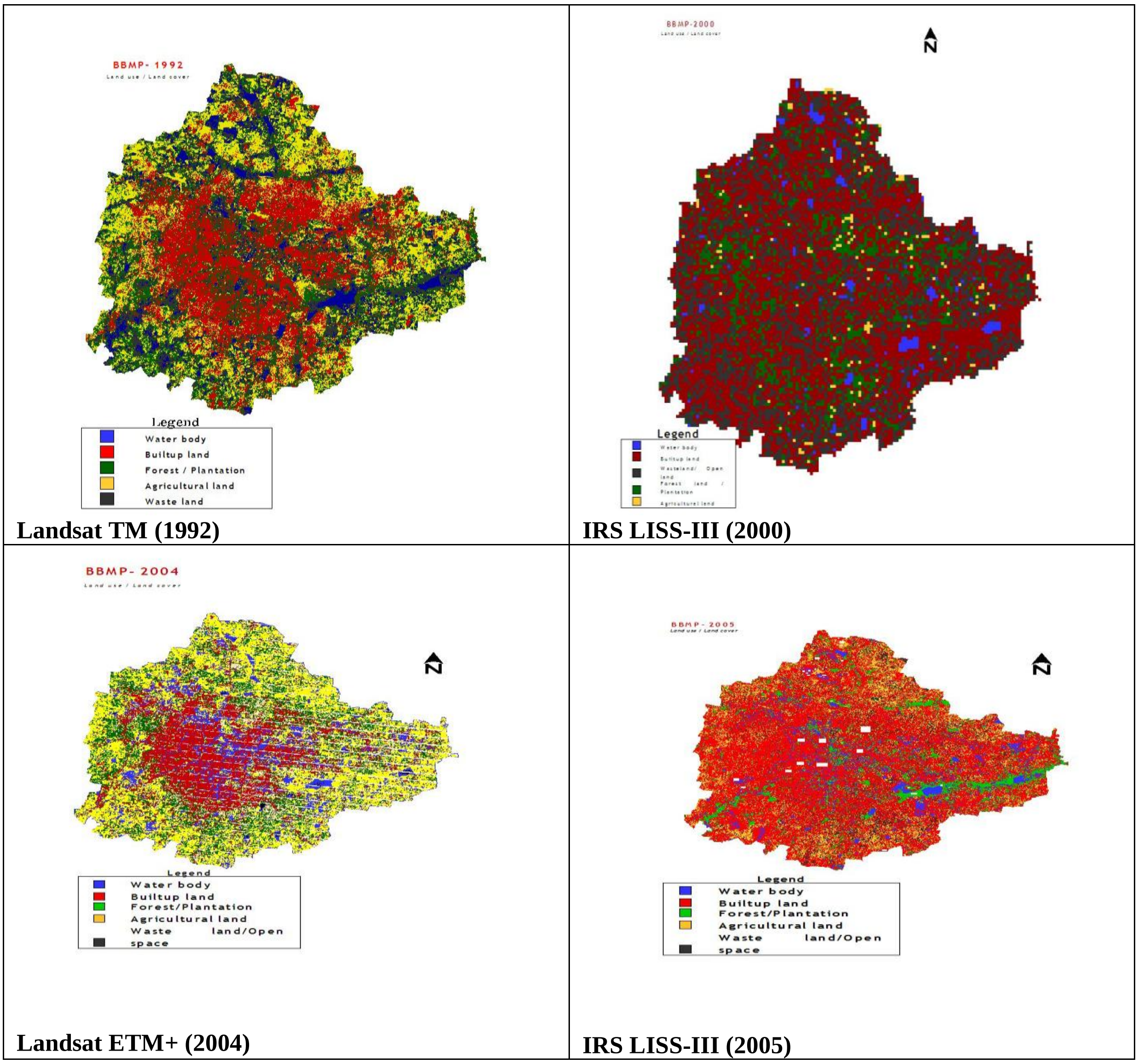
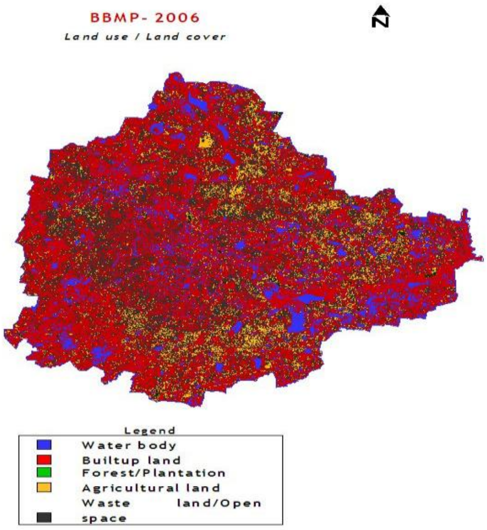
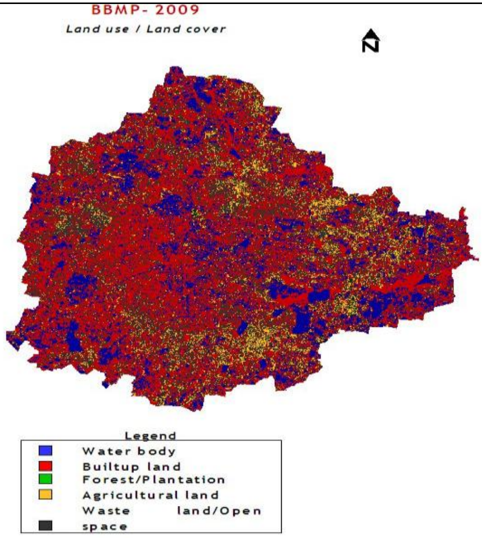


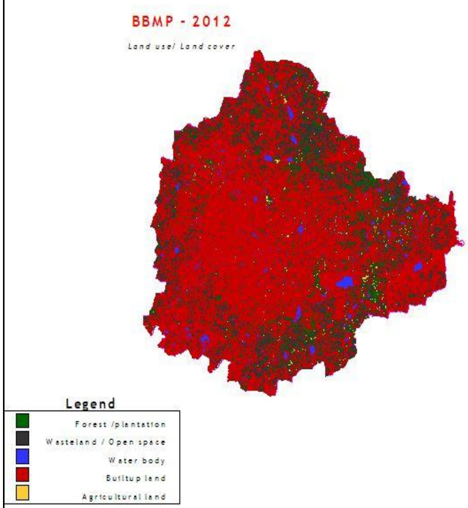
Figure 2: Landuse/Land Cover Pattern of Study Area from 1992 to 2012



IRS P-6 (2006)



IRS P-6 (2009)



IRS P-6 (2012)

Figure 3

Table 3: Population Projection over the Years of Erstwhile BMP

Year	Population (Lakhs)	Percentage Increase
1901	1.63	
1911	1.89	15.95%
1921	2.40	26.98%
1931	3.10	29.17%
1941	4.11	32.58%
1951	7.86	91.24%
1961	12.06	53.44%
1971	16.64	37.98%
1981	29.22	75.60%
1991	41.30	41.34%
2001	56.86	37.68%
2011	84.44	48.50%
2021	125.40	37.68% (Projected)

Source: Census of India data

Land-Use Changes in Bruhat Bangalore

The proportion of land-use changes especially the percentage built-up area, which is a key metric to measure sprawl, were estimated across all the zones of Bruhat Bangalore Mahanagara Palike. The corresponding land-use changes within the BBMP region are shown in Table 4. It was clearly evident that on an average the increase in built-up area in the central zones was from 47.8 %, to 64.2 %, while in outer zones built-up area shot from a mere 6.8 % in 1992 to 25.6 %. This implies that the change in built-up areas in the central zones being about 35 % while the change in built-up areas in the outer zones was nearly 300 %. Perhaps the relatively higher percentage of built-up areas during 1992 in Dasarahalli zone and Mahadevapura zones with 10.04 % and 8.03 % respectively, may be due to the industrial estates in these locations while by 2006 this has increased to 30.32 % and 26.89 %. Further, while the change in built-up areas in central zones increased modestly, this indicated these zones were getting denser. However, it was noted that there was a slight reduction in the percentage built-up area in Bangalore West zone for 2000. Perhaps this should be viewed in the light of classification accuracies for the respective time data. Among the outer zones, Bommanahalli has witnessed the highest relative change in percentage built-up areas from 5.05 to 27.90 indicating the magnitude of growth in the region. Indeed this change in land-use here may be attributed to the IT based companies located in the region and the proximity to the Electronic city along the Hosur Road.

Table 4: Percentage Built-up Areas across Zones

Zone	1992	2000	2004	2005	2006	2009	2012
Bangalore East	35.79	37.30	48.64	49.23	50.93	69.34	72.82
Bangalore West	58.09	54.23	64.12	68.45	69.38	70.87	71.57
Bangalore South	49.54	54.48	67.47	70.89	72.47	76.66	81.67
Bommanahalli	5.05	11.08	21.42	25.78	27.90	71.12	72.34
RRNagara	4.70	8.24	12.23	16.78	18.87	65.57	67.86
Dasarahalli	10.04	16.56	27.64	28.98	30.32	72.54	79.81
Byatarayanapura	6.01	11.15	18.67	20.43	24.01	57.12	74.62
Mahadevapura	8.03	13.28	24.34	25.96	26.89	65.91	72.42

CONCLUSIONS

This study amply demonstrates the use of Remote sensing and GIS to analyze the urban sprawl mapping and detect changes of urban land use/ land cover through different year. Satellite data are found to be useful in mapping and quantifying the extent of urban area in different time periods. New urban region development growing largely towards Bangalore International Airport in the north , Electronic city in South-East, and Software Industrial areas in the east along the main transport route of the city. New urban development occurs mainly on vegetation and agricultural land.

The above study provides a methodology for better estimation of urban growth and population using various land uses with time. Geographical information system (GIS) and satellite images have been used in this study to provide spatial inputs and test the behaviour of urban growth. Such methods may be useful for the urban planning authorities in decision making. GIS and Remote sensing can help a lot in monitoring urban sprawl compared to conventional techniques

REFERENCES

1. **Anderson James, R. 1979. Land Use and Land Cover Changes:** A Frame Work for Monitoring", Journal of Research, United States Geological Survey (USGS), 5 (2), pp-143-153.
2. Fang, F. and Wang, Y. (2009). Evaluating the Temporal and Spatial Urban Expansion Patterns of Guangzhou from 1979 to 2003 by Remote Sensing and GIS Methods. International Journal of Geographical Information Science, Vol 23, Issue 11, pp. 1371–1388.

3. Gautam, N. C. and Narayan, L.R.A. 1982. Suggested National Land Use and Land Cover classification System for India using Remote Sensing Tecniques, Pink Publishing House, Mathura.

4. Lillesand, M. T., KIefer, W. R. and Chipman, N, J. 2008. Remote sensing and image interpretation (6th ed). John Wiley and Sons, Inc, New York.

5. National Remote Sensing Agency, 1989. Manual of Nation wide Land Use / Land Cover Mapping using satellite imagery, Part – I, NRSA, Hyderabad.

6. Ohri A. and Poonam (2012). Urban Sprawl Mapping and Land Use Change Detection Using Remote Sensing and GIS, International Journal of Remote Sensing and GIS, Vol 1, Issue 1, pp.12-25.

7. Rao, D.P. 1991. IRS IA Application for Land Use / Land Cover Mapping in India", Current Science, pp. 153-167

8. Raghavswamy, V. Pathan, S. K., Ram Mohan, P., Bhanderi, R. J. and Padma Priya (2005). IRS-IC applications for urban planning and development. Curr. Science, Vol 70, pp.582–588

9. Read, J. M. Lam, N. S. N. 2002. Spatial methods for characterizing land cover and detecting land cover changes for the tropics. International Journal of Remote Sensing, 23 (12): 2457-2474.

10. Sabins, F. F. 1997. Remote sensing, principles and interpretation. (3rd ed). W. H. Freemanand Company, New York.